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MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

Vol. XXXVII. *January* 12, 1877. No. 3.

William Huggins, Esq., F.R.S., President, in the Chair.

Robert John Baillie, Esq., 10 Bolton Place, Carlisle;
H. Vere Barclay, Esq,, 6 Disraeli Terrace, Putney;
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Samuel Heywood, Esq., 171 Stanhope Street, Hampstead Road;
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Robert Pearce, Esq., Church Court Chambers, Old Jewry;
Commander William James Lloyd Wharton, H.M. Surveying Ship "Fawn;"
Jesse Young, Esq., Stibbington House, Wantsford,

were balloted for and duly elected Fellows of the Society.

Theory of the Horizontal Photoheliograph, including its application to the determination of the Solar Parallax by means of Transits of Venus. By Professor William Harkness, U. S. Navy. (Abstract.)

(*Communicated by the Astronomer Royal.*)

The term "Horizontal Photoheliograph" is used to designate that form of photoheliograph which, it is believed, was first employed by the late Professor Winlock, and which consists essentially of a fixed telescope, whose optical axis is accurately horizontal and in the meridian, and whose objective is directed towards the same side of the zenith as the elevated pole; the Sun's rays being reflected into the telescope by a suitable heliostat. The sensitive plate for the reception of the photographic image is, of course, situated at the chemical focus of the telescope,

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the plane of the plate being perpendicular to, and its centre coinciding with, the optical axis of the telescope.

The heliostat mirror consists of a piece of highly polished (but unsilvered) glass, whose two surfaces make an angle of about sixty minutes with each other. The front surface is worked as truly plane as possible, and serves to reflect the solar rays through the object-glass to the photographic plate. In working the back surface, no particular pains are taken; and, on account of its inclination to the front surface, any light reflected from it is thrown entirely away from the photographic plate. The object-glass is corrected for the chemical, and not for the visual rays. The distance between the object-glass and mirror is made as small as possible, consistently with keeping the latter clear of the shadow of the former. The sensitive surface of the photographic plate faces the object-glass, while the rays from the Sun are reflected by the mirror through the object-glass, and after traversing the reticule, they form an image upon the photographic plate.

The reticule consists of a system of squares, formed by the intersection of two systems of very fine straight lines, which are drawn upon one side of, and respectively parallel to, the edges of a thin square plate of plano-parallel glass. In each of these linear systems the number of lines is odd, and the middle line is drawn through the centre of the plate. This reticule is fixed with its ruled surface toward, parallel to, and two or three millemeters distant from, the sensitive surface of the photographic plate. Moreover, one of the two systems of lines is set as nearly as possible vertical, and its inclination is accurately determined; and, to render assurance doubly sure, a plumb-line, consisting of a silver wire about 0·05 of a millemeter in diameter, is suspended between the reticule and the photographic plate, in such a position that it may hang freely, and at the same time be very nearly in the vertical plane passing through the centres of the reticule and object-glass. As the light from the object-glass traverses the reticule before it reaches the photographic plate, the shadow, both of the reticule and of plumb-line, is impressed upon every picture taken with the apparatus; and thus three different ends are gained: First, by comparing the squares of the reticule with the corresponding ones upon the picture, everything relating to the shrinkage of the collodion can be determined; secondly, the impression of the plumb-line, and also that of the vertical lines, furnishes upon each picture a fixed direction from which to measure angles of position; and, thirdly, the intersection of the middle vertical with the middle horizontal line furnishes a fixed point, which in the paper is designated as the centre of the plate. To determine the zenith distance and azimuth of this point, it is necessary to measure the zenith distance and azimuth of the corresponding point of the reticule, as seen from the second principal point of the object-glass. For that purpose, the mirror is temporarily removed, and a

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transit instrument is set up in front of the object-glass in prolongation of its axis. The object-glass thus becomes a collimator to the transit instrument, through the eyepiece of which the lines of the reticule may be observed as if they were at an infinite distance. It should be remarked, however, that as the reticule is slightly inside the visual focus of the object-glass, it is not generally possible to obtain perfectly distinct vision of its lines and of the wires of the transit at the same time. This difficulty is obviated by marking the intersection of the middle vertical and middle horizontal lines of the reticule in such a distinct manner, that the slight maladjustment of focus does not prevent it from being seen. Then, by means of the transit, the reticule is adjusted so that the point in question is very approximately in the meridian, and at a zenith distance of ninety degrees. Finally, the exact azimuth and zenith distance of the point are measured.

The remainder of Professor Harkness's paper, which will probably be given *in extenso* in the *Memoirs* of the Society, is occupied with a full and detailed explanation, with diagrams, of the principle of the instrument, and of the methods of measurement of the photographs.

Micrometrical Measures of Double Stars. By George Knott. (Abstract).*

I have the honour of presenting to the Royal Astronomical Society a short series of Micrometrical Measures of Double Stars, taken between the years 1860 and 1873, at my former residence, Woodcroft, Cuckfield.

The Observatory, detached at some little distance from the house, and commanding a good horizon view, stood at an elevation above the sea level of about 370 feet, and in the approximate position, latitude 51° 0′ 41″ North, longitude $0^h\ 0^m\ 34^s$ West.

The Equatoreal has an object-glass of $7\frac{1}{3}$-inches clear aperture and $110\frac{1}{2}$-inches focal length, by Messrs. Alvan Clark and Sons of Boston, U.S.A., and is a fine specimen of the makers' skill. It was formerly in the possession of the Rev. W. R. Dawes.

The filar, or parallel-wire, micrometer, employed in the following measures, was made for me by the late Mr. Dollond. It has a position-circle of $3\frac{1}{2}$-inches diameter, reading, by two verniers, to tenths of a degree, and the angle of position is taken by placing the two stars under observation centrally parallel between two thick wires, about 13″ apart. At right angles to the position-wires are the webs for distance-measures, of which two, one

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* The Paper will probably appear *in extenso* in the *Memoirs* of the Society.—Ed.